Ministry of Agriculture, Livestock and Irrigation

Department of Agriculture

Perennial Crops Division

Effect of Organic and Inorganic Fertilizer Application on the Growth of Immature Rubber (*Hevea brasiliensis* Muell. Arg.) and Soil Properties

ရော်ဘာပင်ပျိုတွင် သဘာဝမြေဩဇာနှင့်ဓာတ်မြေဩဇာတွဲဖက်သုံးခြင်းဖြင့် အပင်ကြီးထွားမှုနှုန်း မြေဆီလွှာအပေါ် အကျိုးသက်ရောက်မှုကို လေ့လာခြင်း

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9th February, 2024

Introduction

Rubber

- An important economical plantation crop in Myanmar
- Planted chiefly for latex and timber (rubber wood) (Verheye, 2010)
- Latex can be produced at 7th year of plantation (trunk girth - 50 cm)
- In Myanmar

- Total sown area of Rubber – 661,925 ha (2021-22)
- Mon State, Kayin State, Thanintharyi Division – mainly grown area
- Mon State – Maximum growing area in Myanmar - Over 30%

– Total sown area – 203,125 ha (2021-22)

(DALMS, 2022)

Nutrient management in immature rubber

- Integrated Soil Fertility Management system - reduce input of inorganic fertilizer and apply the combined use of inorganic with organic materials.
- Organic fertilizer – compost, green manure (Oguzar, 2017)

  - provides continuous application of available nutrients with slow release rate (Ikram & Yusoff, 1999)
- Inorganic fertilizer - immediately supply, but excess application lead to soil degradation.
- Poor Nutrient Management - major limiting for plant growth , especially in vegetative development stage.

Compost

- Produced from effective utilization of locally available waste materials (Liu et al., 2016)
- Improved soil physical, chemical and biological properties
- Provide nutrition for plant growth (Wilkinson et al., 2014)

Figure 1. Composting process of yard waste compost

Sunn hemp (*Crotalaria juncea*)

- A legume adapted - wide range of environmental location & soil types.
- Grown for **green manure**, weed control, forage and fiber production.
- Fixed nitrogen (N) and improve soil productivity.
- Produce biomass yield - 2 to 11 t ha^{-1} of dry matter in 40-50 days.
- 100 kg N ha^{-1}, 25 kg P ha^{-1}, 93 kg K ha^{-1}, 43 kg Ca ha^{-1}, 45 kg Mg ha^{-1}

(Mosjiolis et al., 2013)

Figure 2. Cultivation of Sunn hemp for green manure

Objectives

- To compare the effect of compost, green manure and chemical fertilizer on immature rubber and
- To study the changes of soil physiochemical properties by application of compost, green manure and chemical fertilizer

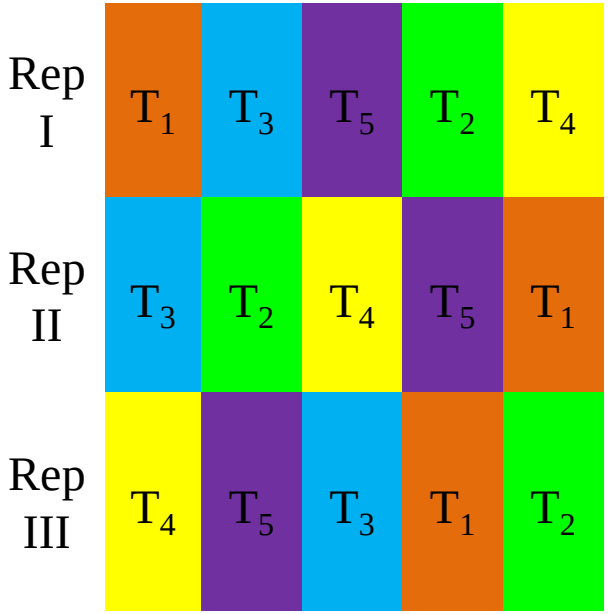


Problem Statement

- Improper and long term use of chemical fertilizer will affect of soil fertility and crop productivity (Sosilawat et al., 2011)
- Expending agricultural sector enlarges disposal of agro-industrial waste, removing this waste becomes a problem (United Nations Conference on Trade and Development, 2003)
- Burning gives the adverse effect on environment and recycling by composting can support nutrients to plants (Wilkinson et al., 2014)
- Proper Nutrient Management can reduce the immature period of rubber plantation and get early tappability (Adiwiganda et al., 1995)

Materials and Methods

Experimental site	-	Perennial Crops Research and Development Center (Mawlamyine)
Experimental design	-	Randomized Complete Block (RCB)
Treatments	-	5
Replication	-	3
Plant spacing	-	20' × 10'
Plot size	-	12 plants
Experimental area	-	1.5 ac
Experimental period	-	June 2022 – December 2023
Tested variety	-	PB 260 (4th year old)



Treatments

T_1 - Chemical fertilizer (C.F) (680 g $tree^{-1}$ $year^{-1}$)

T_2 - Compost (4 kg $tree^{-1}$ $year^{-1}$)

T_3 - Green manure (Sunn hemp) (4 kg $tree^{-1}$ $year^{-1}$)

T_4 - Compost (4 kg $tree^{-1}$ $year^{-1}$) + C.F (680 g $tree^{-1}$ $year^{-1}$)

T_5 - Green manure (4 kg $tree^{-1}$ $year^{-1}$) + C.F (680 g $tree^{-1}$ $year^{-1}$)

- **Organic fertilizer** - Compost, Green manure (Sunn hemp)
- **Compost** - Collect grasses, leaves and poultry manure for Yard Waste Compost.

  Composting method - Pile method (C:N = 30:1)
- **Green manure** - 45 days old chopped Sunn hemp were used.
- **Chemical fertilizer** - 11:18:4:3MgO with the recommended rate
- Each of compost, green manure and chemical fertilizer were applied over a circular band of around the plant base.

Collected data

- Girth (cm)
- Girth increment (cm)
- Girth increment (%)

Analysis of soil samples

(Before and after experiment)

No.	Parameters
1	Bulk density (Bd) kg m^{-3}
2	Texture
3	pH
4	Organic Matter (OM) %
5	Total Nitrogen (N) %
6	Available Phosphorus (P) ppm
7	Exchangeable Potassium (K) mg 100 g^{-1}
8	Exchangeable Calcium (Ca) meq 100 g^{-1}
9	Exchangeable Magnesium (Mg) meq 100 g^{-1}

Table 1. Analytical result of compost and green manure (Sunn hemp) used in the experiment

No.	Experiment	Compost	Green Manure (Sunn hemp)
1	Organic matter (%)	38.26	55.65
2	Nitrogen (%)	2.01	2.66
3	Phosphorus (%)	1.46	2.18
4	Potassium (%)	1.75	1.73
5	Calcium (%)	3.68	3.16
6	Magnesium (%)	1.08	0.50
7	Sulphur (%)	0.94	1.30
8	C:N	11.04	12.14

Data Analysis

- Collected data were analyzed using procedure of Statistix (Version 8.0).
- Mean values were tested by Least Significant Difference (LSD) at 5% of significant.

Results and Discussion

Table 2. The girth (cm) of immature rubber at 6, 12 and 18 months after treatment

Treatment	Girth (cm)		
	6 months after treatment	12 months after treatment	18 months after treatment
T_1 (C.F)	23.32	24.46	28.07
T_2 (Compost)	22.99	25.12	28.55
T_1 (Green manure)	21.87	22.58	26.91
T_4 (Compost+C.F)	21.70	23.84	30.65
T_5 (Green manure+C.F)	22.99	24.09	28.19
$LSD_{(0.05)}$	3.55	3.73	2.92
Pr>F	ns	ns	ns

Ardika et al., (2017) reported that the combined application of compost with inorganic fertilizer support the growth of rubber.

Table 3. The girth increment (cm) of immature rubber at 6, 12 and 18 months after treatments

Treatment	Girth increment (cm)		
	6 months after treatment	12 months after treatment	18 months after treatment
T_1 (C.F)	5.77	6.91	10.53 b
T_2 (Compost)	5.49	7.62	11.05 b
T_1 (Green manure)	5.29	5.99	10.32 b
T_4 (Compost+C.F)	5.21	7.35	14.17 a
T_5 (Green manure+C.F)	5.64	6.74	10.83 b
$LSD_{(0.05)}$	1.42	1.97	1.75
Pr>F	ns	ns	**
CV (%)	13.77	15.12	8.16

In a column, means having the same letter are not significantly different at the 5% level.
ns = Non – significant; ** = Significant at 1% level.

Organic fertilizer application can provide nutrients to the plants. Harjadi (1979)

Table 4. The girth increment (%) of immature rubber at 6, 12 and 18 months after treatments

Treatment	Girth increment (%)		
	6 months after treatment	12 months after treatment	18 months after treatment
T_1 (C.F)	32.85	39.32	59.95 b
T_2 (Compost)	31.61	43.48	63.06 b
T_1 (Green manure)	31.86	36.05	62.25 b
T_4 (Compost+C.F)	31.23	43.92	**87.84 a**
T_5 (Green manure+C.F)	32.68	39.37	62.90 b
$LSD_{(0.05)}$	6.63	11.03	18.17
Pr>F	ns	ns	*
CV (%)	10.98	14.49	14.36

In a column, means having the same letter are not significantly different at the 5% level.
ns = Non – significant; * = Significant at 5% level.

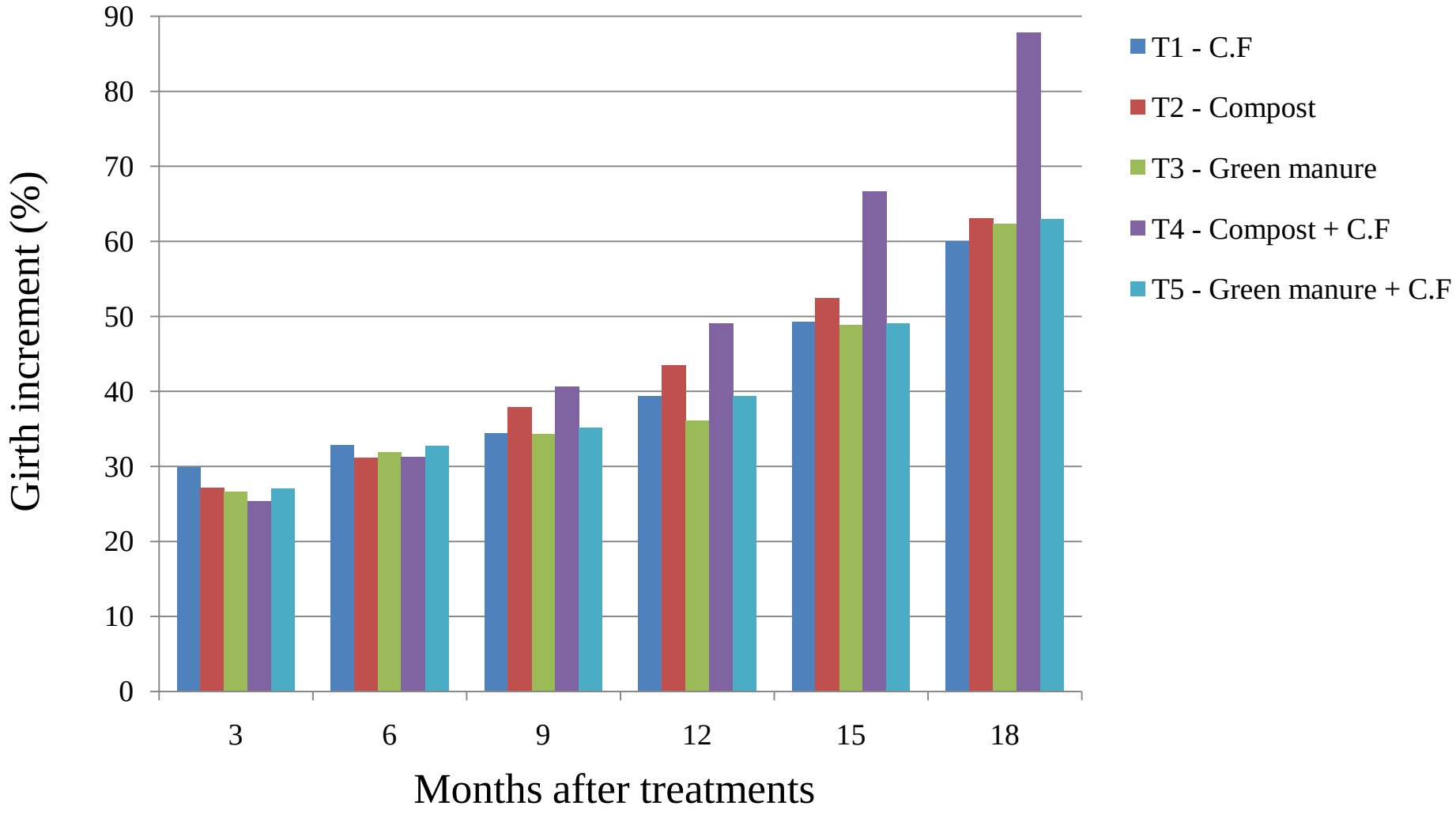


Figure 3. Effect of organic and inorganic fertilizer application on girth increment (%) of immature rubber at 3, 6, 9, 12, 15 and 18 months after treatments

Ismail (1981) stated that the rubber tree shown the effect of fertilizer at about 12 months after application.

Table 5. Some of the soil physicochemical properties of experimental soil at before and 12 months after treatment

Treatment	pH	OM (%)	Total N (%)	Available P (ppm)	Available K_2O (mg $100g^{-1}$)
Before	4.98	2.72	0.13	6.01	6.92
T_1	5.03	2.50 b	0.12	8.91	4.84
T_2	5.28	2.48 b	0.10	10.10	6.26
T_3	5.57	**2.99 a**	0.13	8.91	5.20
T_4	5.39	2.69 ab	0.11	8.91	5.37
T_5	5.27	2.67 ab	0.11	10.1	5.36
$LSD_{(0.05)}$	0.386	0.264	0.018	2.603	2.924
Pr>F	ns	*	ns	ns	ns
CV (%)	3.87	5.27	8.42	14.73	28.73

In a column, means having the same letter are not significantly different at the 5% level.
ns = Non – significant; * = Significant at 5% level.

Table 7. Cost of compost, green manure, chemical fertilizer (kyats ac^{-1} $year^{-1}$)

Treatment	Compost	Green manure	Chemical fertilizer	Total
T_1 (C.F)	-	-	281,000	281,000
T_2 (Compost)	206,150	-	-	206,150
T_1 (Green manure)	-	173,600	-	173,600
T_4 (Compost+C.F)	206,150	-	281,000	487,150
T_5 (Green manure+C.F)	-	173,600	281,000	454,600

Conclusion and Recommendation

- **Girth increment (%)** of only organic fertilizer treatments - (T_2 - Compost), (T_3 - Green manure) show not differ when compare to only inorganic fertilizer (T_1)
- Compost + Chemical fertilizer (T_4) give the highest girth increment of 87.84% among the experiment at 18 months after treatment.
- So, organic fertilizer can be used to reduce for immature period of rubber.

Future Plan

- Experiment will be continued until to get the tappability of rubber tree
- Further studies are still needed to obtain the optimum rate of compost, green manure and chemical fertilizer.

Research Activities of Experiment



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THANK YOU